TRAINING TECHNICAL PERSONNEL FOR THE MINERAL INDUSTRIES OF THE U.S.S.R.

By Bernadette C. Michalski

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TRAINING TECHNICAL PERSONNEL FOR THE MINERAL INDUSTRIES OF THE U.S.S.R.[1]

by

Bernadette C. Michalski[2]

INTRODUCTION

Mineral raw materials, labor, capital, and technology form the basis of industrial production. The augmentation of one or all of the elements--labor, capital, and technology--will result in industrial growth. Thus, an increase in the labor force would increase output. A similar result would be achieved by expanding capital investment and supplying labor with more equipment. Finally, industrial growth can be achieved by introducing more productive methods and techniques born of technological advancement.

The Soviet Union has employed these elements in many patterns to catapult from an agricultural to an industrial economy in four decades. The early history of the Soviet Union was marked by limited capital and borrowed technology, forcing the Soviets to concentrate on an abundant labor reserve to support the industrial program. The source of this reserve was the rural population. In 1928, 80 percent of the working population was employed in agriculture. This figure dropped to 43 percent by 1956, whereas industrial employment in the same period increased from 8 to 31 percent.[3]

The loss of lives and a decreased birth rate during World War II cost the Soviet Union a potential labor force of 15 million. The full impact of this deficit will be thrust upon industry in 1959-65. As the Soviet birth rate has not yet reached its prewar level, the shortage is likely to continue in less acute form throughout the 1960's. The Soviets have attempted to cushion this crisis by transferring emphasis from labor to technology. To insure a maximum of competent technical personnel, heavy emphasis was placed on higher and secondary-level training throughout the immediate postwar years. Between 1946 and 1956 enrollment in higher educational establishments and secondary schools more than doubled.

Because it underlines the changing emphasis from labor to technology, the education program has undergone numerous alterations since the war. With the labor shortage at its peak in this period of transition, the Soviets must combat the dual problem of maintaining an adequate supply of manpower to alleviate the shortage and preparing technological cadres for the future. To implement this program, the Soviets have pressured their youth into industrial occupations while encouraging the pursuit of academic studies via extension courses in part-time evening or correspondence schools. Under this new program, 2 to 3.5 million adolescents will be brought into industry yearly.[4]

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[1] Work on manuscript completed May 1959.

[2] Commodity research assistant, Division of Foreign Activities, Bureau of Mines, Washington, D. C.

[3] Union of Soviet Socialist Republics, Central Statistical Office, Narodnoye Khozyaistvo SSSR v 1956 Godu (National Economy of the U.S.S.R. in 1956): Gosudarstvennoye Statisticheskoye Izdatel'stvo Moscow, 1957, p. 201.

The objective of this paper is to clarify methods and techniques employed by the U.S.S.R. in training technical personnel for the extractive industries.

INDUSTRIAL TRAINING PROGRAMS

In a planned economy such as exists in the U.S.S.R., technical training is centrally controlled to respond to the demands of a growing industry. Individuals are trained in the capacity that will best suit the current industrial setup. Thus, all technical training, whether semiskilled or professional, is characterized by a high degree of specialization. Students are encouraged in their choice of specialization by the State system of stipend allotments and career-advancement opportunities. Heavier allotments are awarded students preparing for positions in industries scheduled for expansion. These conditions, together with the competitive aspects innate in a tuition-free education system, have contributed to the high scholastic standards of Soviet institutions. However, as in all phases of Soviet society, Communist Party pressure groups exert their influence to the advantage of their favorite sons and daughters. Thus, a favorable political personality often equates the scholastically average with the scholastically superior.

Labor Reserve School--Training Semiskilled and Skilled Laborers

The training of semiskilled and skilled labor is the responsibility of the Labor Reserve schools. These vocational schools are established at mines and metallurgical plants to train workers for careers in specific operations. General education courses are avoided in these schools, which are comparable to the trade schools in the United States. As the labor shortage is acute in the semiskilled and skilled labor positions, strong measures have been adopted to divert, at least temporarily, much of the youth to this area.

The original training program under the Labor Reserve School System was the factory-plant training center. These schools, operating at factory expense, trained semiskilled workers for mine, ore-dressing, and metallurgical-plant work.

The threatening labor shortage prompted expansion of the Labor Reserve School System. In August 1954 it was resolved to place 250 additional schools in the system. These schools offer 10-month to 2-year courses in some 76 skills. In the 10-month course students are trained in such work as coal cutter or cutter-loader operator, shovel operator, or operator of metallurgical-plant machinery. Newly incorporated into the system is the 2-year training program giving the students a greater degree of proficiency in these skills.

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[4] Pravda, Moscow, Sept. 21, 1958, p. 2.

Labor Reserve schools are the major training centers for skilled labor. Some large-scale metallurgical combines, such as Magnitogorsk, Kuznets, and Novotagilsk, report that about 40 percent of the qualified workers in these plants are graduates of the Labor Reserve School System. In the Dniepropetrovsk metallurgical plant named after Molotov, Labor Reserve School students comprise 75 percent of the personnel. The Maria Glubokaya mine in the Donets coal basin reports 90 percent of the workers as Labor Reserve School graduates.[5]

The Soviet coal-mining industry with its lack of skilled workers relies heavily on the Labor Reserve School training program. Soviets boast that after Labor Reserve School training, the best recruits increased the productivity of coal cutting combines by as much as 1,600 to 1,900 tons per month. Although these figures are impressive, they do not necessarily reflect superior achievement on the part of the recruits. Having started at a low production level, the recruit is only bound by an increment in monthly output that is in keeping with the overall productivity of the Donets coal basin.

In addition the call for volunteers to replenish the labor force in the coal mines brings thousands of green crecruits yearly from all over the U.S.S.R. and even from satellite countries. From the Ukraine alone, 16,000 workers were recruited for the Donets coal basin in 1955.[6]

At the completion of the fifth Five-Year Plan (1950-55), the Labor Reserve schools had prepared 2,364,400 qualified workers for industry. Of this number, 260,300 (or 11 percent) were trained for the coal industry, which employs about 5.5 percent of the total industrial labor force.[7]

Like the Labor Reserve schools, the Soviet technicums are pressed by the labor-for-industry program. With reservations, the technicum may be compared to the semiprofessional schools in the United States. The technicum curricula include general studies as well as technical courses. The technicum, however, offers a wider range of technical courses and demands more specialized study than the U.S. semiprofessional school.

Technicums--Training Semiprofessionals

In the engineering technicums, which include all the mineral-industry professions, required class attendance is high throughout the 4-year program. Actual class instruction exceeds 1,500 hours per annum, compared with 1,200 hours in nonengineering technicums.[8]

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[5] Professional'no-Tekhnicheskoye Obrazovaniye (Professional Technical Education): No. 2 (129), Moscow, February 1956, p. 12.

[6] Radyans'ka Ukraina, The Devoted Band of Young Miners: April 6, 1956, p. 1.

[7] Profession'no Tekhnicheskoye Obrazovaniye (Professional Technical Education): Vol. 131, No. 4, Moscow, April 1956.

[8] DeWitt, Nicholas, Soviet Professional Manpower: National Science Foundation, Washington, D. C., 1955, p. 75

The general 4-year curriculum of a student in a mining-engineering technicum, for example, is divided approximately as follows, in percent of total hours:[9]

Subject:	Percent of total hours
Humanities (history of the U.S.S.R., Russian language and literature, foreign language)	13
General science (mathematics, physics, chemistry)	11
General technical courses (drawing, mechanics, electrotechnology, machinery, technology of metals)	12
Special courses (geology, mining, surveying mine mechanics, principles of coal recovery, mine safety, other)	28
Industrial experience (actual work in plants)	33
Military training and physical education	3
Total	100

This curriculum may vary slightly, depending on the specialization of the student. However, general education is limited, and originality and individuality of approach are foreign to the technicum graduate.

The 10-year general middle school (7-year compulsory general school combined with 3-year secondary general school) parallels the technicum in the Soviet secondary-level education program. This school roughly corresponds to the U.S. high school; however, training in the general sciences far exceeds the training offered in U.S. high schools. (See fig. 1.) As much as 43 percent of the study program in the 10-year general middle school is devoted to general sciences. Until recently, the more gifted elementary-school students have been encouraged to enter the 10-year general middle school, as it provides a less specialized, and therefore more satisfying, base for university training than the technicum. However, by 1950 the 10-year, general-middle-school graduates had swelled to such numbers that the universities were unable to absorb them. Although this situation may have fostered a greater selectivity of applicants, it also expanded the ranks of the unemployed. An age-old Russian conception that a secondary-school graduate should not have to work with his hands resulted in mass refusal of the graduates to enter industrial work. In Leningrad, only 400 of the 25,000 rejected 1953 applicants of higher educational institutions sought work in industry.[10] In the 3-year period 1954-57, 2.5 million 10-year-school graduates throughout the U.S.S.R. were not admitted to higher institutions.[11] Although the U.S.S.R. was faced with a growing shortage of skilled manpower, unemployment ranks were swelling. To

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9/ Work cited in footnote 8, p. 291.
10/ Komsomalskaya Pravda: Moscow, Aug. 25, 1954, p. 1
11/ Pravda, Moscow, Nov. 16, 1958, p. 2.

remedy this paradoxical situation, a new technicum program designed for the 10-year-school graduate was begun in 1953. This program omits all general studies and concentrates on specialty training. The training program lasts 2.5 years, as opposed to the regular 4-year technicum course. In the fall of 1953 more than 50,000 middle-school graduates entered this program. By 1954, the 10-year-school graduates comprised 25 percent of the technicum students. This percentage doubled in the 1956-57 school year.

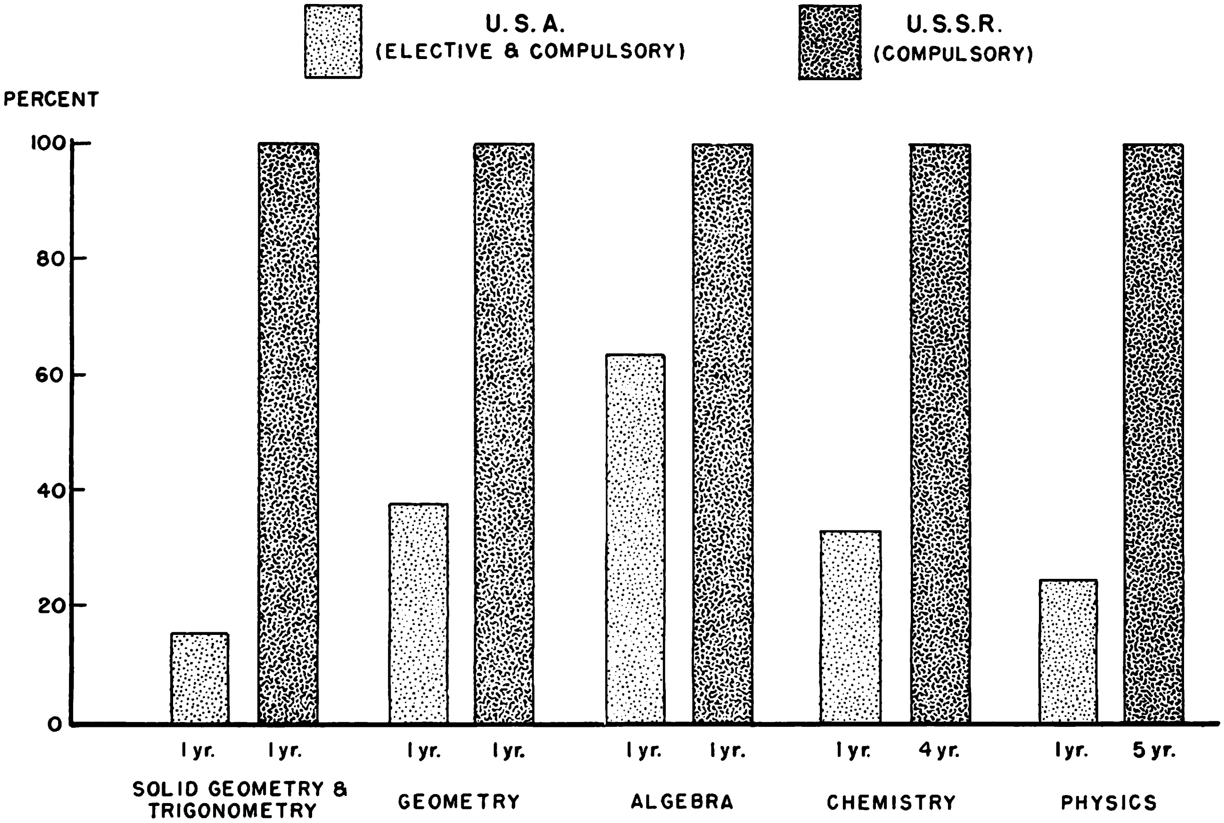

FIGURE 1. - General Science in High-School Curriculums: U.S.A. Versus U.S.S.R. Comparison is made by percent of total enrollment and duration of course.

The Mitishchinskii Industrial Technicum in the Moscow Oblast is an example of how the new program has been incorporated into the curriculum. Before the 1953 decree, the technicum offered regular 4-year courses in such fields as silicate technology (ceramics) and open-pit mining of coal and nonmetallic mineral deposits. Under the new program, the technicum includes a 2.5-year course in these specialties, as well as in geology and mineral exploration. This technicum, like many others throughout the U.S.S.R., not only has accelerated training in the existing specialties but also has incorporated into the curriculum an entirely new specialty--exploration. As technicum expansion has taken priority over expansion at the overcrowded university or institute, it is evident that the manpower deficit is more serous in the skilled-labor and semiprofessional fields than in the highly technical field.

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An effort is made to place all 10-year graduates not entering the 2.5-year technicum program in industry, where they can be trained as skilled or semiskilled laborers by the Labor Reserve School system already mentioned. For this purpose, an "engineering college" has been incorporated into the Labor Reserve School system. Schools of this type offer a 1-year training course to high-school (10-year, general-middle-school) graduates to prepare them as skilled workers and junior supervisory staff members.

Another vital part of the Soviet technical training program is the correspondence and evening school courses. This program permits further technical training of labor without interrupting industrial productivity. Correspondence schools are highly publicized, and attendance is encouraged. Correspondence and evening courses are offered by divisions of regular semiprofessional schools, as well as by schools established exclusively for this purpose. The Moscow Mining Technicum is one of the larger and better equipped correspondence schools. Students are prepared in underground coal extraction, open-pit coal and mineral mining, planning in the mining industry, and briquetting hard coal. Unlike the Moscow Mining Technicum, which is purely a correspondence school, the Magnitogorsk Industrial Technicum for metallurgy offers regular day courses in addition to correspondence and evening courses. To aid the students in their training throughout the year, field counselors are sent to remote districts. Correspondence and evening students also have an opportunity to perform practical laboratory work at the various affiliated stations established by the correspondence and evening schools. Frequently, these stations are at industrial enterprises. For example, the Moscow Metallurgical Technicum has established an affiliate at the Serp i Molot steel plant. At this plant some 120 correspondence students of the Moscow Metallurgical Technicum attend consultation sessions (1957).

The following table shows the number of students graduating from day and extension (correspondence and part-time evening) courses of mineral-industry technicums:12/

Specialty	Graduates from day courses		Graduates from extension courses	
	1950	1955	1950	1955
Geology and mineral exploration..	1,807	5,579	1	47
Mining.........................	5,970	12,811	8	142
Metallurgy.....................	4,854	4,102	81	436
Total.....................	12,631	22,492	90	625

The technicum programs for training semiprofessionals have evidently proved successful in supplying industrial technical manpower. A continued heavy emphasis upon technicum training is planned for the future. The establishment of new technicums will be most prevalent in Siberia, where industry is developing at an accelerated pace but the technical-manpower supply is low.

12/ Union of Soviet Socialist Republics, Central Statistical Office, Kul' turnoye Stroitel' stvo SSSR (Cultural Development in the U.S.S.R.): Gosudarstvennoye Statisticheskoye Izdatel'stvo Moscow, 1956, p. 241.

Although expanding technicum training in Siberia does not improve the immediate skilled-labor shortage in that area, it promises technical manpower for future needs. Soviet officials estimate that about 40,000 additional skilled workers, engineers, and technicians will be required to carry through various Siberian metal and mineral projects during the next 5 years. A small percentage of this manpower will be supplied by the already existing technicums and institutions of higher learning in this region; however, the major technical manpower source will continue to be the European educational establishments.

That technical training is a tool of Soviet central planning is illustrated by the fact that large sums of money have recently been allocated (as much as 100 million rubles in 1956 alone) for the expansion of Ural and Far Eastern technicums specializing in nonferrous metals--a mineral-industry field in which the Soviet Union has been experiencing chronic shortages and which is now slated for expansion.13/ In 1956, 5,000 semiprofessionals were graduated from the technicums specializing in geology, mining, and metallurgy of nonferrous metals. Of this number, 1,100 geological and mining specialists were sent to the Siberian Dalstroy projects, which hold considerable promise in the nonferrous metals field. This shift of manpower to the underdeveloped eastern regions is done with relative ease. Job assignments of 4 years' duration are determined by a branch of the Ministry of Higher Education. These Government-determined assignments are somewhat of a payment by the graduate for his tuition-free training.

While the Soviet attempt to divert students from full-time academic studies to industrial productivity has had measurable success, it has yet to combat smaller, reluctant forces. In spite of continuous pressures from the Ministry of Education, industry is neglecting to employ the 10-year graduates. Heavy demands wrought by production quotas allow no room for recruits whose interests do not lie with their immediate work and who consider their job as a forced delay in their educational program. Another reason why management does not wish to employ 10-year-school graduates is that most of them are affected by the Soviet law which requires that shorter working hours be granted those under 18 years of age.14/ This provision tends to disrupt plant and mine operations.

The new education program, first proposed by Nikita Khrushchev in September 1958, assures industry a labor force "borrowed" from academic studies. This program, which is to be conducted on an experimental plane in the fall of 1959, proposes that the Soviet student complete an 8-year general-education course combined with polytechnic studies, so that he may enter industry as semiskilled labor at the age of 15. While working in industry, the graduate

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13/ Pravda, Moscow, Apr. 4, 1957, p. 3.

14/ Laborers between the ages of 15 and 16 are permitted only a 4-hour working day, while those between the ages of 16 and 17 work a 6-hour day. Vacations are extended to 1 month for workers under 18 years of age, as opposed to 2 weeks for other workers.
Pichugin, E. P., Pravo na Obrazovaniye v SSSR (Education Laws in the U.S.S.R.): Izdatel'stvo Akademiy Nauk, Moscow, 1957, pp. 13, 14.

from an 8-year elementary school may acquire special skills at the factory school or he may seek secondary education by correspondence- or evening-school study. Training in the secondary school will include some general studies in a curriculum heavily laden with technical courses. Those elementary-school graduates already working in professions related to their chosen field of study are favored for admission to evening and correspondence classes. Technicums and Labor Reserve schools will be reorganized into this new system of schools for working youths. The training period will be 3 years. Students successfully studying in their spare time are released from production 2 or 3 days a week to attend formal classes and laboratory sessions. This absence from the production line is another factor disrupting existing plant and mine schedules and undoubtedly will be met with some protest by management.

It is contemplated that the period of transition from the old to the new programs will be completed by 1965; thus, students in the present 8th to 10th grades are given an opportunity to conclude their secondary education under the familiar pattern (fig. 2), with an accent on labor training.

Universities and Institutes--Training Professionals

Undergraduate Program

Undergraduate studies in the Soviet Union are offered in universities and technical institutes. As at all levels of Soviet education, specialization is advocated. The institute student of geology, mining, or metallurgy may specialize in any 1 of 30 fields of applied study. (See table 3, p.18). The university student, also a specialist, concentrates on research problems.

In competing with industrially matured capitalist societies, the Soviet Union grants priority ratings to all phases of industrial expansion. The drive for more qualified engineers is one facet of this program. The vast untapped mineral resources east of the Ural Mountains, scientific research aiming at greater mineral self-sufficiency, and technical-aid programs to underdeveloped areas all require numerous technologists. As the Soviet Union is comparatively new to the industrial scene, the country has a chronic need for technically trained personnel. This need is not as acute in an industrially matured society.

With the threat of a labor shortage approaching, the Soviet Government attempted to divert students from full-time academic studies to industry as early as 1950. However, it was not until 1957 that the Ministry of Higher Education announced that no applicant having less than 2 years of practical industrial experience would be considered for university or institute training.[15] This move was particularly designed to channel into industry secondary-school graduates who refused to seek employment while awaiting admission to higher institutions of learning. In conjunction with this program, the study of higher educational courses through correspondence and evening schools

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[15] In 1958 only 70 percent of the new enrollment satisfied the industrial experience requirement. Additional applicants were accepted to fulfill the student quota.

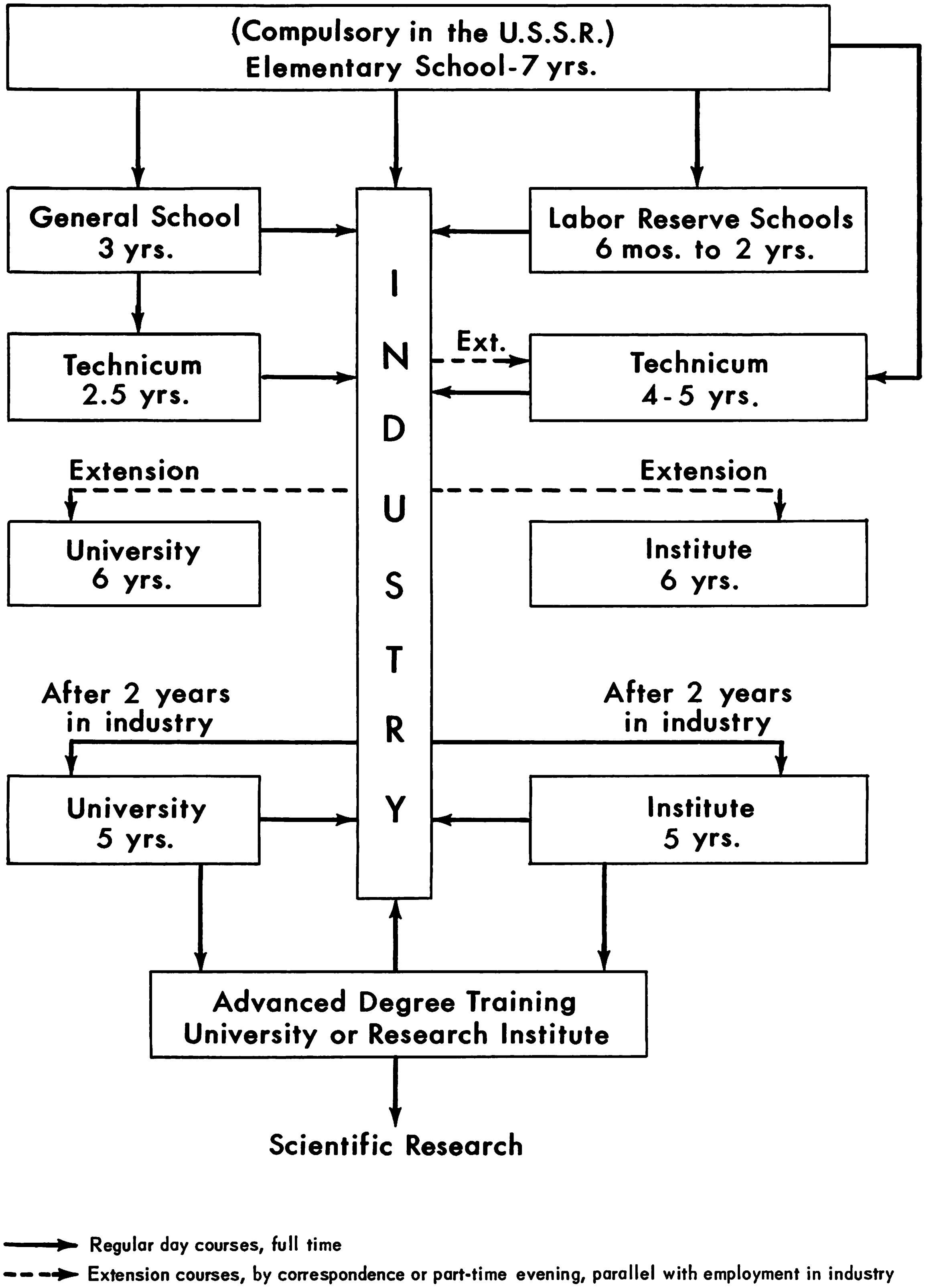

FIGURE 2. - Soviet Education Pattern.

was and continues to be highly promoted, and many higher educational establishments have expanded the facilities of their evening and correspondence courses. Several correspondence schools have been established. The largest is the All Union Polytechnic Correspondence Institute in Moscow, which has nine departments, including mining, metallurgy, and petroleum.

The evening school is another facet in the Soviet extension-course program. While most universities and institutes offer both evening and regular day-school courses, several exclusively evening schools have been established. The largest is the Moscow Metallurgical Institute. Students attend lectures 4 evenings a week, completing the course in 5 years and 9 months. Upon entering the institute, the student is obligated to accept a position in a plant with a similar field of specialization. The standards maintained are similar to those maintained at the regular day schools. Soviet figures show that 18,000 or more of the 145,000 first-year college students studying for industry and construction in 1955 were evening-school students.[16/]

The new experimental education program, effective in the fall of 1959, does not appear to alter seriously the higher education program for students of the mining and metallurgical industries. While students majoring in most other fields must rely heavily upon extension courses for their secondary training, it is proposed that most students of the extractive industries will attend regular day classes for at least 3 years. Some Soviet educators suggest that this exception is necessary because of the nature of the curriculum in this field. Once the 3-year regular day courses are completed, the student, while continuing his studies by extension courses, is assigned a junior technical position in industry. The final stage in the undergraduate program is the return to the higher educational establishment for additional courses and the diploma project. This proposal is but one of several put forth by the Ministry of Higher Education, and the accepted pattern will be chosen only after several years of varied educational experiences. The total program consists of 5 to 5-1/2 years of study (possibly including 3 years of combined work and study), and is equivalent in time input to a Master's degree in the United States.

However, as Soviet engineering is so highly specialized, it is impossible to make a general comparison between Soviet academic degrees and those of the United States. Alexander Korol, of M.I.T.'s Center for International Studies, believes that in some cases the 5-year Soviet engineering student is far too specialized to qualify as more than an advanced technician in the United States.

While the study of general science and basic engineering courses at the college level is similar in both the United States and the U.S.S.R., the humanities have for the most part been replaced by specialty training in the Soviet institutions. (See fig. 3.)

The Soviet practice of establishing higher educational institutions in areas with related industries fosters a high degree of specialization. Steel

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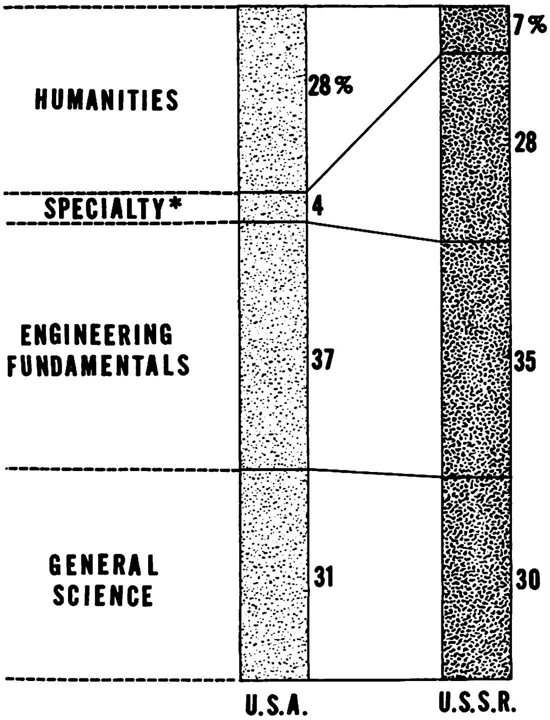
[16/] Work cited in footnote 12 (p. 6), p. 213



*The figure for the U.S.S.R. does not include time devoted to specialized industrial and diploma projects.

FIGURE 3. - Course Distribution of Engineering Curriculum: U. S. A. Versus U. S. S. R. U. S. curriculum occupies 4 years, against 5 years in the U.S.S.R.

centers like Dnepropetrovsk and Magnitogorsk have several metallurgical institutes and technicums. Moscow enjoys an abundance of institutes with affiliates in other industrial areas. For example, the Moscow Mining Institute has an affiliate at Stalinogorsk where coal is mined.

Table 1 compares U.S.S.R. and U.S. engineering schools and graduates in 1955.

Graduate Program

Advanced-degree study in the Soviet Union is highly specialized. The first advanced degree offered in the Soviet Union is that of Candidate. In the better universities and research institutions, this degree is comparable to the Ph. D., but it represents a greater degree of specialization than the Ph. D. The aspirant to this degree undertakes a 3-year comprehensive study-research program planned to suit his individual needs. During the first 2 years of graduate study, the aspirant must pass oral examinations in two modern languages, field of specialization, dissertation subject, and Marxist-Leninist communist ideology. These examinations, known as the Candidate-degree qualification minimum, assist in gaging progress. The Candidate degree is awarded by the Institute or University and confirmed by the Supreme Attestation Committee of the Academy of Sciences (VAK). The next advanced degree, the Doctorate, is awarded Candidates who have distinguished themselves in their area of specialization through extensive research work.

Advanced-degree studies in the Soviet Union are closely coordinated with existing research projects. However, advanced degrees may be earned not only in the regular higher educational establishments but also in industry and the research institutes of the Academy of Sciences. One of the largest and best-equipped of such research establishments is the All Union Coal Mining Research Institute in Moscow, where advanced-degree students perform research work in one of the specialty projects assigned to the institute, such as the investigation of rock pressure, roof supports, or dust prevention and suppression. Short-term research is emphasized.

TABLE 1. - Total number of graduates in mineral and metallurgical studies in the U.S.A. and the U.S.S.R. in 1955

Field	United States		Soviet Union[1]	
	Number of schools	Number of graduates	Number of schools	Number of graduates
Mineral geology and exploration...	29	182	31	3,976
Geophysics........................	6	25	11	(2/)
General mining....................	34	204	24	5,290
Petroleum.........................	25	466	8	(3/)
Metallurgy........................	52	449	16	2,656
Total......................	146	1,326	90	11,923

1/ Figures do not include those of the secondary-level technical schools in the Soviet Union.

2/ Number of graduates may be included in the figure for mineral geology and exploration.

3/ Number of graduates may be included in either the figure for mineral geology and exploration or in the figure for general mining.

Source: United States, Department of Health, Education, and Welfare, Office of Education, Engineering Enrollments and Degrees in 1955: Circ. 468, Washington, D. C., 1956, p. 14.

Union of Soviet Socialist Republics, Central Statistical Office, Kul'turnoye Stroitel'stvo SSSR (Cultural Development in the U.S.S.R.): Gosudarstvennoye Statisticheskoye Izdatel'stvo, Moscow, 1956, p. 217.

Soviet advanced students have access to translated foreign studies. These translations are made readily available by the Institute of Scientific Information of the U.S.S.R. Academy of Sciences. This institute, established in 1953 for the purpose of publishing foreign scientific studies in Russian, employs on a full-time basis approximately 2,000 translators. The Soviet student is well informed about foreign developments in his field of interest.

INCENTIVES

Material awards in the Soviet Union are high in the academic science field. Soviet sources claim that one-half of the 130,000 Soviet scientists are professors and instructors. Full professors of science in the U.S.S.R. are paid at least 10 times as much as the average laborer. A comparable salary in this country (8 to 10 times greater than the salary of an average laborer) would be $35,000 per annum.[17] Aside from high salaries, the Soviet scientists enjoy social prestige and fringe benefits. These benefits include better housing facilities, better quality and quantity of food, and chauffeured automobiles. The highest career achievement possible to the Soviet scientist is membership in the Academy of Sciences, which originated during the period of Peter the Great (1724). Membership in this highest scientific body of the U.S.S.R. is awarded in recognition of superior attainment in the

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17/ Cotton, Clare, and Haller, Ellis, Soviet Science: Russia Hikes Outlays, Speeds Research, Bids to Outclass the U.S.: Wall Street Journal, New York, June 13, 1956, pp. 1, 15.

ield of specialization. While the responsibilities of the academician are igh, he is generously rewarded for his efforts. In addition to top salaries nd numerous benefits, pensions are granted retiring academicians. Table 2 ists academicians of the Soviet Union who have specialized in fields related o the mineral industries.

TABLE 2. - List of academicians of the Soviet Union who have specialized in geology, metallurgy, or mining

Academician	Year elected	General field	Specialty
ardin, I. P......	1932	Metallurgy..	Ferrous metallurgy.
etekhtin, A. G...	1953	Inorganic chemistry	Nonferrous metals.
ochvar, A. A.....	1946	Metallurgy..	Machine engineering; alloys.
ikushin, V. I....	1953	Mechanical engineering	Metal-cutting equipment; complex automation in machine engineering.
rigor'ev, I. F.[1]	1946	Geology.....	Mineral deposits; distribution of rare minerals.
udtsov, N. T.....	1939	Metallurgy..	Theory of physical metallurgy of steel.
arnaukov, M. M...	1953	...do.......	Steel.
orzhinskii, D. S.	1953	Petrography.	Petroleum industry.
ironov, S. I.....	1946	Petroleum...	Petroleum geology; geophysical methods in petroleum prospecting; microfauna of petroleum regions.
alivkin, D. V....	1946	Geology.....	Stratigraphy; paleontology; Urals and Central Asia; geological surveying.
bruchev, V. A....	1929	...do.......	Theoretical problems of tectonics; mineral surveying; genesis of forests; Siberia and Central Asia.
Pavlov, M. A......	1932	Metallurgy..	Theory of blast-furnace processes.
Polkanov, A. A....	1943	Geology.....	Petrography; stratigraphy.
Satpaev, K. I.....	1946	...do.......	Formation of iron and manganese deposits; geology of mineral deposits in Kazakhstan.

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[1] Not mentioned in Soviet publications since 1950, most likely because of inactive participation or political disfavor.

TABLE 2. - List of academicians of the Soviet Union who have specialized in geology, metallurgy, or mining (Con.)

Academician	Year elected	General field	Specialty
Shatskii, N. S....	1953	Geology.....	Tectonics; geotechnics; geological surveying.
Shcherbakov, D. I.	1953	...do.......	Geochemistry.
Sheviakov, L. D...	1939	Mining......	Location of mineral deposits.
Skochinskii, A. A.	1935	...do.......	Mining aerology; prevention of mine fires.
Terpigorev, A. M..	1935	...do.......	Distribution of useful minerals; mechanization of mining processes.
Topchiev, A. V....	1949	Organic chemistry	Transformation of coal.
Urazov, G. G......	1946	General and inorganic chemistry	Physicochemical analysis of metallic elements.
Vinogradov, A. P..	1953	Chemistry...	Geobiochemical problems; chemical defense; geochemistry; distribution of rare elements in soil of Soviet plains.

Source: Vucinich, Alexander S., The Soviet Academy of Sciences: Stanford University Press, Stanford, Calif., 1956, 157 pp.

SUMMARY

The advancement of Soviet industry is strongly dependent upon the technological-education programs of the U.S.S.R. In full realization of this fact, the Soviets have planned the education programs as carefully as they have planned industrial development. To support industrial advances, the Soviet student is encouraged to enter the technological and science field as early as the elementary-school level, where emphasis is placed upon the general sciences and workshop practice. The stress upon the sciences is continued throughout the various levels of education, growing in intensity as the student advances in training. At the general secondary school, which enrolls 50 percent of the Soviet youths in that age group, more than half of the students' time is devoted to general sciences. Every graduate of the Soviet general secondary school has completed mathematics courses through trigonometry. In comparison, U.S. high schools enroll 75 percent of the American youths in that age group, but only 37 percent of the graduates have had geometry and less than 65 percent have taken algebra. Most of the science courses, however, are taken by the college-bound students, who comprise about one-half of the total high-school enrollment. Soviet general-school graduates have 4 years of chemistry,

whereas only 32 percent of U.S. high-school graduates have had 1 year or more of chemistry. In physics, the differences are even greater. Only about 24 percent of U.S. high-school graduates have had physics courses, whereas all Soviet general-school graduates have had 5 years of physics.[18, 19]

The same continued emphasis upon the sciences is found in the trade schools, universities, and institutes, where technicians and engineers get favored treatment both financially and academically. All training is highly specialized. Only in the U.S.S.R. is such training possible, for it requires central planning not only as to education but also as to industrial and other economically dependent units. Because all training and research is centrally planned, there is little room for individual initiative and personal research projects. The trained engineer must serve in the capacity and at the location most useful to the national economy. Thus, the Soviet student is offered free training in exchange for the subordination of personal initiative, desires, and comforts. Job assignments are centrally controlled, offering the Soviet Union an opportunity to shift manpower to the underdeveloped eastern regions with relative ease.

Unlike the U.S. worker, whose job mobility is high, the Soviet laborer, technician, or engineer is frozen in the job. No amount of experience on the job will qualify a Soviet laborer for a position as mine or plant supervisor. This position can only be filled by the man trained for the job in a Labor Reserve school or its equivalent in the new system. Engineering-technician positions are filled only by graduates of technicums, and advancement depends upon continued academic study and research.

The Soviet economy is, however, threatened by a serious labor shortage resulting from the heavy fatalities of World War II and the slow increase in birth rate in the postwar years. The Soviets plan to alleviate this problem by diverting college students into industry while encouraging their enrollment in extension courses. As material rewards are considerably higher in the fields of advanced technology, most industrious students should not be deterred by the temporary delays.

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[18] Medynskiy, E., Narodnoye Obrazovaniye v SSSR (Popular Education in the U.S.S.R.): 2d ed., Moscow, 1952, pp. 59, 74, 86.

[19] United States, Department of Health, Education, and Welfare, Office of Education, Offerings and Enrollments in Science and Mathematics in Public High Schools: Washington, D. C., 1956, 44 pp.

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TABLE 3.—*Institutes of the Soviet Union offering specialties in geology, mining, and metallurgy, 1958–59*

Map No.[1]	Institute	Location	Specialties																																	
			Geology and mineral exploration	Prospecting	Geophysical prospecting	Engineering geology and hydrogeology	Surveying	Metallurgical industry, economics and organization	Metallurgy	Metallurgical furnaces	Nonferrous metallurgy	Ferrous metallurgy	Foundry production of ferrous and nonferrous metals	Metallurgical technology	Technology of metal stress	Equipment and technology of thermal processing	Physical metallurgy	Metallurgical equipment	Mining industry, economics and organization	Mining	Mineral beneficiation	Mining electromechanics	Mining equipment	Petroleum and gas industry, economics and organization	Petroleum and gas, geology and prospecting	Petroleum and gas mining	Petroleum and gas refining	Refinery equipment	Petroleum drilling equipment	Gasification and gas supply	Fuel technology	Peat surveying	Peat mining	Hydropeat production	Peat production equipment	Silicate technology (ceramics)
1	Tallin Polytechnic Institute	Tallin																		X											X					X
2	Leningrad Chemical—Technical Institute	Leningrad																													X					X
3	Leningrad Industrial Correspondence Institute	do							X			X			X	X																				
4	Leningrad Mining Institute (G. V. Plekhanov)	do	X	X	X	X	X				X								X	X		X														
5	Leningrad Polytechnic (M. I. Kalinin)	do						X	X	X	X	X	X		X	X		X																		
6	Northwest Correspondence Polytechnic Institute	do	X						X			X	X		X			X		X			X													
7	Byelo-Russian Polytechnic Institute (J. V. Stalin)	Minsk																															X		X	X
8	Lwow Polytechnic Institute	Lwow			X																				X	X	X	X								X
9	Kiev Polytechnic Institute	Kiev							X				X			X		X																	X	
10	Krivoy Rog Mining Institute	Krivoy Rog	X				X												X	X	X	X														
11	Dneprodzerzhinsk Evening Metallurgical Institute	Dneprodzerzhinsk							X	X		X	X		X	X		X																		
12	Dnepropetrovsk Chemical-Technical Institute	Dnepropetrovsk																													X					X
13	Dnepropetrovsk Metallurgical Institute (J. V. Stalin).	do						X	X	X		X	X		X	X	X	X													X					X
14	Dnepropetrovsk Mining Institute (Artema)	do	X	X	X	X	X												X	X	X	X	X													
15	Kharkov Mining Institute	Kharkov					X												X	X	X	X	X													
16	Kharkov Polytechnic Institute (V. I. Lenin)	do	X				X												X	X	X	X	X													
17	Donets Industrial Institute (N. S. Khrushchev)	Stalino	X				X	X	X			X			X	X			X	X	X	X	X													
18	Voroshilovsk Mining—Metallurgical Institute	Voroshilovsk										X			X					X		X														
19	Novocherkassk Polytechnic Institute (S. Ordzhonikidze).	Novocherkassk	X			X	X												X	X		X														X
20	North Caucasus Mining—Metallurgical Institute (S. Ordzhonikidze).	Ordzhonikidze	X								X									X	X	X														
21	Groznyy Petroleum Institute	Groznyy				X																		X	X	X	X	X	X							
22	Georgian Polytechnic Institute (S. M. Kirov)	Tbilisi	X	X	X							X	X		X			X	X	X		X														
23	Yerevan Polytechnic Institute (K. Marx)	Yerevan																																		X
24	Azerbaijan Industrial Institute (A. Azizbekov)	Baku			X	X																X		X		X	X	X		X						
25	All-Union Correspondence Polytechnic Institute	Moscow	X	X	X	X	X	X	X	X	X	X				X		X	X	X	X	X	X	X	X	X	X		X		X					X
26	Moscow Chemical—Technical Institute (D. I. Mendeleyev).	do																													X					X
27	Moscow Geological Exploration Institute (S. Ordzhonikidze).	do	X		X	X	X																													
28	Moscow Metallurgical Institute	do							X	X		X	X		X	X	X																			
29	Moscow Mining Institute (J. V. Stalin)	do					X												X	X	X	X	X													
30	Moscow Nonferrous Metals and Gold Institute (M. I. Kalinin).	do	X					X	X		X				X	X				X	X															
31	Moscow Peat Institute	do																													X	X	X	X	X	
32	Moscow Petroleum Institute (I. M. Gubkin)	do	X																					X	X	X	X	X	X							
33	Moscow Steel Institute (J. V. Stalin)	do							X	X		X	X		X	X	X	X																		
34	Moscow Technical Institute	do														X		X																		
35	Tula Mining Institute	Tula																	X	X		X														
36	Gorkiy Polytechnic Institute (A. A. Zhdanov)	Gorkiy							X				X			X		X																		X
37	Kazan Chemical—Technical Institute (S. M. Kirov).	Kazan																									X									
38	Kuibyshev Industrial Institute	Kuibyshev																								X	X	X	X							
39	Ufa Petroleum Institute	Ufa																								X	X		X							
40	Perm Mining Institute	Perm																	X	X		X	X													
41	Sverdlovsk Mining Institute (V. V. Vakhrushev)	Sverdlovsk	X	X	X		X												X	X	X	X														
42	Ural Polytechnic Institute (S. M. Kirov)	do						X	X	X	X	X	X		X	X		X																		
43	Chelyabinsk Polytechnic Institute	Chelyabinsk										X		X				X																		
44	Magnitogorsk Mining—Metallurgical Institute (G. I. Nosov).	Magnitogorsk							X			X			X	X		X		X	X	X														
45	Karaganda Mining Institute	Karaganda					X					X			X				X	X		X	X													
46	Middle Asiatic Polytechnic Institute	Tashkent	X	X	X	X														X		X														
47	Frunze Polytechnic Institute	Frunze	X																	X																
48	Kazakh Mining—Metallurgical Institute	Alma-Ata	X		X	X	X				X									X																
49	Tomsk Polytechnic Institute	Tomsk	X	X	X	X	X												X	X	X	X			X											
50	Kemerovo Mining Institute	Kemerovo																	X	X		X														
51	Siberian Metallurgical Institute (S. Ordzhonikidze).	Stalinsk							X	X		X	X		X	X	X	X		X		X														
52	Zhdanov Metallurgical Institute	Zhdanovo							X			X		X	X	X		X																		
53	Irkutsk Mining—Metallurgical Institute	Irkutsk	X	X	X		X				X							X	X	X	X	X														
54	Far East Polytechnic Institute (V. V. Kuibyshev)	Valdivostok	X	X																X		X														

[1] Number refers to location on fig. 4.

Source: Union of Soviet Socialist Republics, Ministry of Higher Education, Spravocnik Dlya Postupayushchikh v Vysshiye Uchebniye Zavendeniya SSSR v 1958 (Handbook for Applicants to Higher Educational Establishments in the U.S.S.R. for 1958): Izdatel'stvo Moskovskaya Pravda, Moscow, 1958, 295 pp.

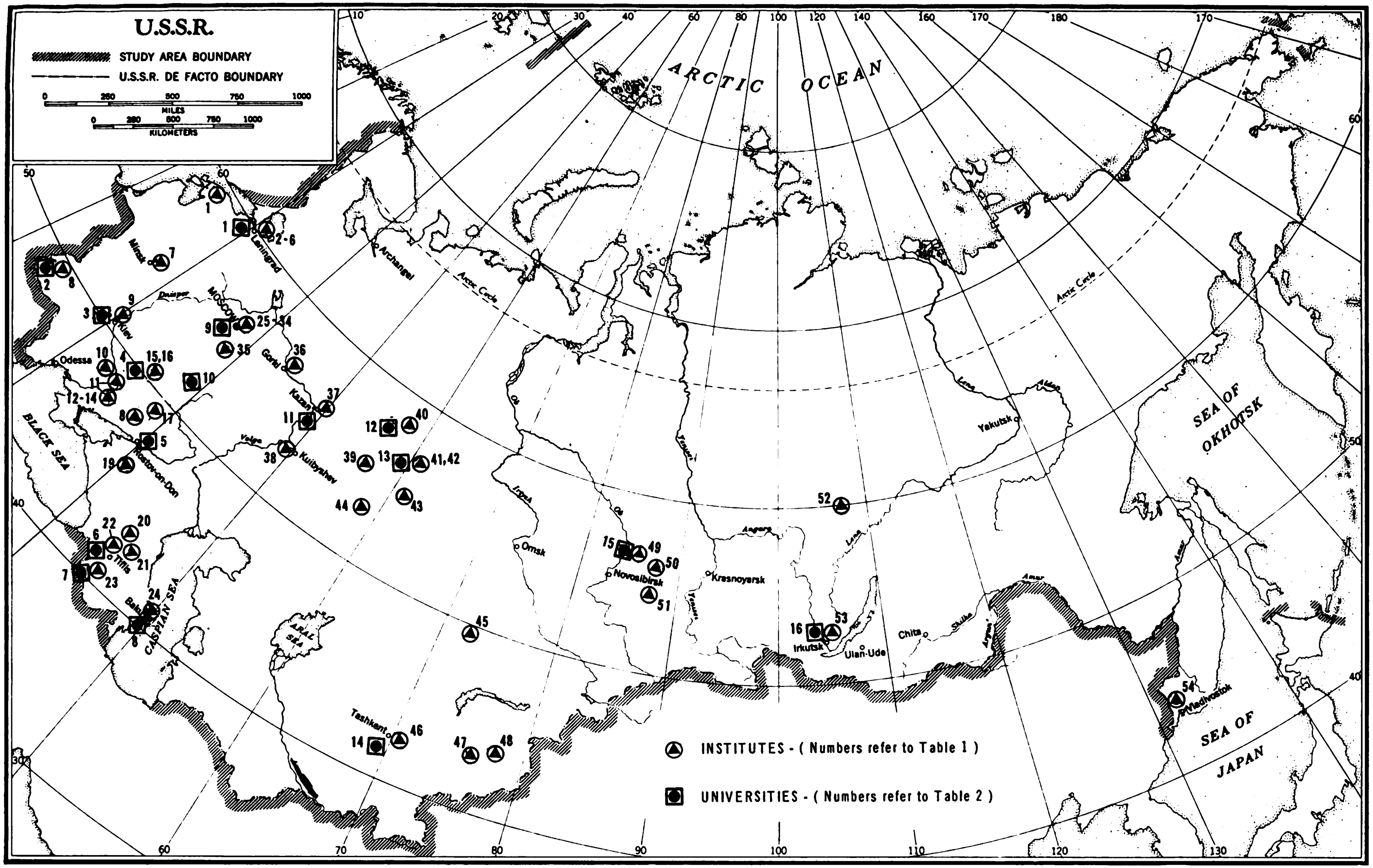

FIGURE 4. - Location of Institutes and Universities Offering Courses in Geology, Metallurgy, and Mining.

TABLE 4. - Universities of the U.S.S.R. offering courses in geology

Map No.1/	University2/	Location	Total enrollment in faculty during 1955-56	Geological survey	Geology and mineral prospecting	Geology and prospecting petroleum and gas	Mineral geo-physics	Geological engineering	Hydro-geology	Geo-chemistry
1...	Leningrad State University (A. A. Zhdanov)	Leningrad.	837	x	x		x	x	x	x
2...	Lwow State University (Ivan Franko).......	Lwow......	393	x	x					
3...	Kiev State University (T. G. Shevchenko)..	Kiev......	527	x	x		x	x	x	
4...	Kharkov State Univeristy (A. M. Gorkiy)...	Kharkov...	306	x	x			x	x	
5...	Rostov State University (V. M. Molotov)...	Rostov....	406	x	x					
6...	Tbilisi State University (J. V. Stalin)...	Tbilisi...	514	x	x					
7...	Yerevan State University (V. M. Molotov)..	Yerevan...	373		x					
8...	Azerbaydzhan State University (S.M.Kirov).	Baku......	760	x	x					
9...	Moscow State University (M. V. Lomonosov).	Moscow....	1,179	x	x	x	x	x	x	x
10...	Voronezh State University................	Voronezh..	360		x					
11...	Kazan State University (Ulyanov-Lenin)....	Kazan.....	926	x	x	x	x			
12...	Perm State University (A. M. Gorkiy)......	Perm......	572		x			x	x	
13...	Ural State University (A. M. Gorkiy)......	Sverdlovsk	256	x	x					
14...	Middle Asiatic University................	Tashkent..	704	x	x			x	x	
15...	Tomsk State University (V. V. Kuibyshev)..	Tomsk.....	513	x	x				x	x
16...	Irkutsk State University (A.A.Zhdanov)....	Irkutsk...	436		x	x				

1/ Number refers to location on fig. 4.

2/ Degrees in mining and metallurgy are not offered in universities.

Sources: Union of Soviet Socialist Republics, Central Statistical Office, Narodnoye Khozyaistvo SSSR v 1956 Godu (National Economy of the U.S.S.R. in 1956): Gosudarstvennoye Statisticheskoye Izdatel'stvo, Moscow, 1957, pp. 243-263.

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